Micro. Notes. 02

Loop (with Counter)

- We can loop for ~~Specific~~ Specific number of times using DJNZ instruction

```
DJNZ  Counter, TARGET
      ↳ register OR Port
```

- This instruction will Decrement the Counter then Check if it ~~is~~ not equal Zero then Jump to target otherwise, ~~it~~ Continue normal Flow of execution

```
      MOV   R2, #10   } Loop for 10 times
LOOP: DJNZ  R2, LOOP  }
```

- 8051 Registers are 8-bit So we can Loop to 255 if we need more we should use nested Loop

Example: Loop for 700 times

```
      MOV   R1, #7
LOOP1: MOV  R2, #100
LOOP2: DJNZ R2, LOOP2   → inner
       DJNZ R1, LOOP1   → outer
```

Conditional Jump

		Jump
JZ	target	→ if A = 0
JNZ	target	→ if A ≠ 0
DJNZ	R0, target	
CJNE	R0, #80, target	→ if R0 ≠ 80
JC	target	→ if Carry = 1
JNC	target	→ if Carry = 0
JB	P0.1, target	→ if bit (P0.1) = 1
JNB	P1.0 target	→ if P1.0 ~~#~~ = 0
JBC	C, target	→ if C = 1

JBC Instruction

- This instruction check if the bit = 1
- If that is true Jump and Clear that bit

CJNE instruction (slide 222)

- This instruction is used to Compare two Values
- The Comparision is performed by Subtracting the two Values without Change Values in registers
- It only change the Carry

```
      CJNE  A, R0, NOT_EQUAL
      .....
NOT_EQUAL: JNC, A_G_R0   → jump not Carry
```

- If the Carry = 1 that mean [A - R0] → result is negative → A < R0
- If the Carry = 0

A ≥ R0

Un Conditional Jump

1. Short Jump

```
SJMP target
```

- It take only 2 Bytes
- the first byte for opcode
- the Secnd byte is a relative address (-128 → 127)

Address	opCode	Instruction	
0007	XX 06	SJMP	target
0009	XX ●	NOP	

```
00 0F   target: NOP
```

0F - 09 = 06

- لاحظ أنه يتم حساب الـ relative address بالإعتماد على عنوان الأمر التالي لعملية القفز إلى العنوان الذي يتم الإنتقال إليه

~~0007 - 0009~~

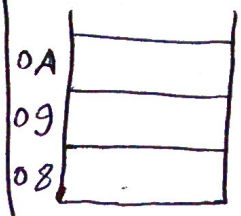
0007 - 0009 = 06

- لابد أن يكون الفرق في حدود -128, 127

- جميع Short Jump من نوع Conditional Jump

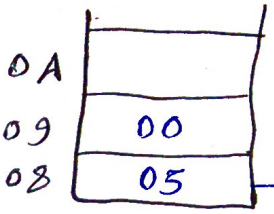
Address	Instruction
0002	LCALL XYZ
0005	NOP

Stack



SP = 07

after LCALL



SP = 09

Look At slide 117

- pop
- push

بترتيب عكس

2 Long Jump

- It take 3 bytes
- The first byte for opcode
- The other two bytes is the absolute Address of the target

LJMP target

The CALL Instructions

1 Long Call (LCALL target)

- 3-bytes instruction
- there are two bytes for address

~~Short Call~~

2 absolute Call (ACALL target)

- 2-bytes instruction
- 11 bits are used for address

- The CALL instruction Store the content of Program Counter in Stack before Jump
- The RET instruction is used to pop [PC] from stack and back to instruction after Call

Delay in 8051

- Delay depends on
  1. Crystal frequency
  2. Design of 8051

For 8051

* Crystal freq. = 11.0592 MHz
* Clocks per Machine Cycle
  - depend on Design
  - Default = 12

To Compute machine Cycle

$$\text{machine freq.} = \frac{\text{Crystal freq.}}{\text{Clocks per Machine cyc.}}$$

$$\text{machine cycle} = \frac{1}{\text{machine freq.}}$$

Common no. of machine cycles for Common Instruction

MOV	1
DEC	1
INC	1
DJNZ	2
LJMP	2
SJMP	2
NOP → no operation	1
MUL AB	4
Push	2
POP	2
RET	2

Look At Examples at Slides 123 → 127

Example

Write Delay Subroutine to introduce 100 ms delay

$$\text{Machine freq.} = \frac{11.0592}{12} = 921.6 \text{ KHz}$$

$$\text{machine cycle} = 1/921.6 \text{ KHz} = 1.085 \mu s$$

The required no. of machine cycles

$$\text{no. cycle} = \frac{100 \text{ ms}}{1.085 \mu s} = 92165.89 \simeq 92166 \text{ cycles}$$

We try to use two nested Loop

```
                          Cycle
Delay: MOV R1, ** 200 → X   1
Outer: MOV R2, ** 228 → Y   1
Inner: DJNZ R2, inner       1
       DJNZ R1, outer       1
       RET                  1
```

MOV → 1
MOV → 1 * X
DJNZ → 1 * X * Y
DJNZ → 2 * X
RET → 2

$$92166 = 3 + 3X + 2XY$$

Assume $X = 150$
$Y \simeq 305 > 255$

Assume $X = 200$
$Y \simeq 229$